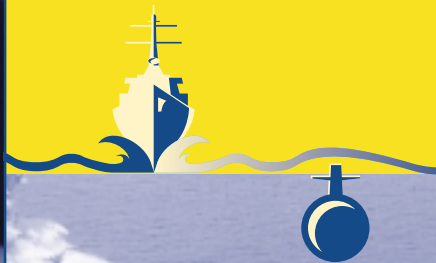


Naval Sea Systems Command

**Carderock Division, Naval Surface Warfare Center**



# Survivability, & Structures & Materials

DIRECTORATE



The **survivability, structures and materials** Directorate is a recognized leader in research, development, test and evaluation (RDT&E), fleet and acquisition support, in-service engineering, and life cycle management for surface ships and submarines. Along with its industrial, academic, and other DoD partners, it provides the U.S. Navy with the superior vision and knowledge necessary to maintain the technical edge for the world's leading naval Fleet.

The Directorate, a part of the Naval Sea Systems Command's (NAVSEA) Carderock Division, is a premier scientific and engineering laboratory for hull, mechanical, and electrical (HM&E) systems. As a member of the **navsea team**, the Survivability, Structures and Materials Directorate contributes technical depth and specialized facilities to meet Navy needs and requirements and to advance maritime technology. In this regard, the Directorate continually seeks opportunities to partner with academia and the shipbuilding and maritime industry.

The Survivability, Structures and Materials Directorate operates on three **principles** "Do what is right, do our best, and treat others as we would like to be treated."

**experience** *experience*

**materials**

**survivability**

**expertise**

**structures**

**processes**

**environmental  
quality**

**focus** *focus*

**in-service  
engineering**

**vulnerability**



# survivability

underwater explosion • protection and weapons effects

Our in-depth understanding and vast experience in studying the phenomenology and dynamic effects of complex damage mechanisms on marine structures and ship systems provides a breadth of knowledge unparalleled in the United States.

We work with numerous organizations to transfer this knowledge in more survivable ship designs. Our full service RDT&E capabilities provides the Navy with combat ready ships able to sustain damage and continue their mission while “fighting hurt.”

## Capabilities & Expertise

- Ship/Submarine protection against dynamic loading
- Underwater explosion trials and analysis
- Ship Vulnerability Modeling (SVM) & Lethality assessments
- Hardened ship and armor concepts
- Fire protection, modeling and application
- Damage prediction models and weapon lethality assessments
- Live Fire Test & Evaluation support and Total Ship Survivability support
- NAVSEA shock test management
- Component shock qualification and test procedures
- Verification and validation of modeling and simulation



# structures

structures • composites



Ours is the only substantive organization in the U.S. performing RDT&E on marine structures, as well as the only full-spectrum technical capability supporting ship and submarine structures. We house in-depth knowledge of requirements, physical behavior, and system-level performance of ship and submarine structures.

## Capabilities & Expertise

- Numerical and physical structural modeling
- Structural reliability databases and structural integrity risk analysis for affordable design
- Design procedure and criteria development
- Historical experience in load structural response (seaway, ice, air, UNDEX)
- Hull and component strength (including propulsors)
- Ship and submarine structural concepts and composite structures
- Computational structural mechanics and structural design codes / analysis
- Large scale structural laboratory testing and at-sea evaluations



# environmental quality

With our technical expertise and world class facilities, we function as the Navy's resident RDT&E organization for the design and engineering of environmental protection and pollution prevention systems for ships and submarines. We are the technical center for in-service engineering, life cycle support, shipboard integration, certification and crew operational and maintenance training of pollution control systems. We are the developer of biotechnology for environmental compliance, biofouling, and biosensors.

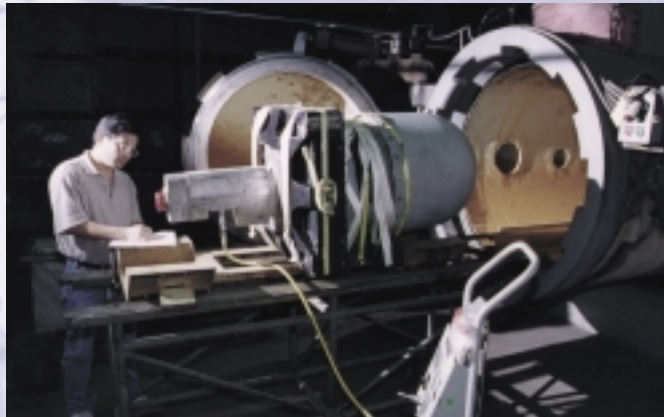
## Capabilities & Expertise

- Conduct RDT&E to develop waste treatment and material management systems to meet U.S. Navy, national, and international ship solid and liquid waste discharge requirements
- Operate a full spectrum laboratory to conduct science, technology, concept development, systems engineering, and full scale prototyping, design, and test and evaluation of shipboard systems
- Integrate logistics support documentation, calibration, inspection and Fleet training
- Identify and implement equipment and management practices to reduce usage and disposal of hazardous materials
- Conduct environmental quality systems in-service engineering and Fleet support



# *in-service* **engineering**

Through its understanding of the shipboard environment and experience in the operating fleet, the in-service engineering capability stands unique. We are the engineer and advisor for survivability, structures and materials product/system use, performance, modernization, maintenance and repair, and implementation. Our deck-plate rapport provides valuable feedback and insight in identifying incipient problems.

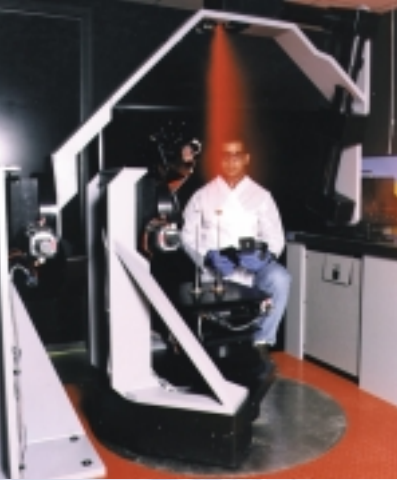


## **Capabilities & Expertise**

- Shipboard investigation and identification of emergent problems
- New process/product application and waterfront interface
- Laboratory and shipboard testing of products and processes
- Calibration and quality assurance for personnel dosimetry
- Failure analysis of materials, ship structures, and components
- Ship system nondestructive evaluation inspections

# materials

metals • composites • processing • nonmetallic materials • advanced materials



Our ship and submarine materials work has impacted all aspects of the Fleet for over 90 years and continues into the 21st Century.

The work is full spectrum from research, concepts, development, and testing to application of metallic and nonmetallic materials for Navy platforms. The core of our business is the understanding of marine and ship platform-related effects on materials and the design of special function materials.

## Capabilities & Expertise

- Development of naval alloys (ferrous, non-ferrous and welding consumables)
- Development of polymer matrix composite materials and processing
- Arc welding and non-destructive evaluation
- Fatigue and fracture, failure analysis, and "fitness for purpose" assessments
- Marine corrosion (aqueous and marine gas turbines)
- Signature control materials
- Fire safe materials (focus on organic composites)
- Advanced metal processing (spray forming, metal-matrix composites)
- Ceramic and magnetic materials
- Coatings and corrosion control
- Battery and radiation technology



## Deep Submergence Tanks

Contains eight pressure tanks that replicate the ocean depths and provides the Navy and Maritime Industry with the capability to test structures, components, and systems (up to 35 feet long and 13-foot diameters). Each tank has the highest operating pressure for its diameter of any quick-opening test tank in the United States. The 10-foot diameter spherical tank is the only explosive-rated tank in the United States and may be used to study shock effects on submarine structures at depth.

## Explosive Test Pond

Only facility in the United States capable of performing precision-scaled experiments to study underwater weapon effects. Water is continually filtered for clarity allowing use of high speed photography to 1000 frames/second to document underwater explosion events. The pond is pentagonal, approximately 135 feet on a side and 25 feet deep. Up to three pound bare charges may be used here.

## Ship Materials Technology

The Ship Materials Technology facility will usher in the use of advanced materials and processes into the Fleet of the 21st century. The facility encompasses capabilities for developing advanced materials, engineering mechanics, chemical formulation, testing and characterization of metallic and non-metallic materials, and the prototype production and testing of ship systems, and components.



## Structure Evaluation Laboratory

Provides the facilities needed for testing large, heavy structures like full-size ship components and sections under tri-axial loads. It is capable of developing loads necessary to test a 1/3-scale model of a destroyer to failure. Typical large-scale tests record several hundred channels of data simultaneously as well as provide analysis and graphical displays of data arrays.



## Underwater Explosions Testing at Aberdeen Proving Ground

Provides the capability to perform a broad range of underwater tests for both surface and submarine applications under controlled conditions while preserving our nation's natural resources. Underwater test capabilities include unique shock qualification and underwater tests for naval subsystems, torpedoes, warheads, missiles, mine warfare vessels/systems, amphibious vehicles and landing craft, large-scale vehicles, prototype ship structural sections, and acoustic studies.

# programs

## *past* past

- High Yield (HY) Strength Steels
- Submarine Structural Design
- Ship Vulnerability Modeling
- Ship & Submarine Shock Test and Trials
- Anti-Fouling Coatings
- Submarine Atmosphere Control
- 1st Generation Environmental Quality Systems
- Radiation Shielding and Dosimetry
- Plastic Waste Processor and Solid Waste Pulpers

## *present* present

- High Strength Low Alloy (HSLA) Steels
- Composite Materials (Advanced Enclosed Mast Structure)
- Special Hull Treatment Acoustic Materials
- Double-Hull Ship Structures
- Environmentally-Safe Paint Removal and Application Systems
- Submarine Propulsors
- Live Fire Test & Evaluation
- Advanced Lithium Batteries
- Shipboard Graywater & Blackwater Treatment

## *future* future

- Carrier Island Design
- Plasma Arc Solid Waste Destruction System
- Surface Ship Composite Material Structures
- Magnetostrictive Materials
- Simulation/Modeling for Survivability and Lethality Prediction
- Submarine Sail Design
- Ship Structural “Health Monitoring”
- Low Signature Materials

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The Carderock Division NSWC is responsible for research, development, test and evaluation, fleet support, and in-service engineering for surface and undersea vehicles and associated hull mechanical, and electrical systems and propulsors. Another integral part of its mission is logistics R&D and support to the Maritime Administration and maritime industry.

The Carderock Division is a major technical component of the Naval Sea Systems Command. It is also recognized as the principal Navy resource, the national focal point and international leader in surface and undersea vehicle science, ship systems, and related maritime technology. The Division serves as a source of innovative technology for other national priorities, such as environment, energy and transportation. The Division has approximately 4,000 employees at various locations around the country including a major site at Philadelphia, and operational detachments as far away as Alaska. Approximately 1,700 of the Division's employees are located at its headquarters in West Bethesda, Maryland.



Surface Warfare Center Division



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